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ZOOLOGY.—*On the relations of the sectional groups of Bulimulus of the subgenus Naesiotu Albers.* WILLIAM HEALEY DALL, U. S. National Museum.

The Naesioti are developed in considerable profusion in the Galapagos Islands. They are related to the small translucent ground snails of the genus *Bulimulus*, which are common to the elevated forest region of South America nearest to the islands and which were probably transported originally to the Galapagos group by high winds while attached in a state of hibernation to dead leaves or similar light material. After reaching the islands their opportunity for evolution into a variety of types was fostered by isolation, differences of food supply and the modifications due to volcanic dust from the disintegrating lavas. In a report to the California Academy of Sciences on the species collected by Mr. W. H. Ochsner of their Galapagos expedition, prepared in 1916, but still unprinted, their relation to situs, distribution among the islands, and apparent protective modifications are discussed at length, and in 1896<sup>1</sup> some of the probable causes of the peculiarities developed in such insular faunas were considered. Nothing in the landshell fauna lends weight to the hypothesis that these islands were ever connected by land with the continent of South America. The Tertiary fossils obtained by the Cal-

<sup>1</sup> *Insular landshell faunas especially as illustrated by the data obtained by Dr. G. Baur in the Galapagos Islands.* Proc. Acad. Nat. Sci. Phila. August, 1896, pp. 395 to 459, pl. 15-17. Also supplementary data in the same periodical for 1900, pp. 88-96, pl. 8.

ifornia Academy's Galapagos Expedition also indicate that isolation was complete at least as early as Pliocene time, and present an interesting admixture of west American and Indo-Pacific types.

By their superficial characters these shells are easily divided into more or less closely related groups, some of which are restricted in their range to particular islands or groups of islands. Sectioning reveals that some of these are more emphatically characterized by internal structure, the possession of internal laminae not visible from the aperture and features of the columellar axis. Of these groups at least fifteen are recognizable, and several of them are so well marked as to have received names from the earlier students. Only in recent years has the fauna been sufficiently well known to enable the less emphatically characterized groups to be recognized, and I believe no one hitherto has made a systematic study of the internal characters of the shells while the first contribution to a knowledge of their anatomy was contained in my monograph of 1896. A summary of the groups follows.

Group of *N. achatellinus* Forbes (*Rhaphiellus* Pfeiffer, 1851).

This species is strictly arboreal and appears to be rare. As with the *Achatinellas* it exhibits more attractive coloration and variability of pattern than the ground-loving species. The axis is tubular and quite simple.

Group of *N. nux* Broderip (*Naesiotus* Albers, 1850).

*N. nux* Broderip, with five varieties.

*N. asperatus* Albers (not of Reibisch).

*N. bauri* Dall.

These are chiefly arboreal, living on trees and bushes but descending to shelter on the ground, in some cases, for hibernation. They are confined to Charles and Chatham Islands and their associated islets. The axis in general is slender, partly twisted and simple, the anterior portion tubular. The aperture is unarmed, the surface dull and wrinkled, the form stout, and the shell substance solid.

Group of *N. planospira* (**Granucis** n.).

*N. planospira* Ancey.

*N. rugulosus* Sowerby.

*N. invalidus* Reibisch.

*N. approximatus* Dall.

This group is confined to Charles Island so far as authentic records go, except *approximatus*, which hails from Hood Island and differs in surface from the others. These shells are more elevated and delicate

than the preceding group, the surface spirally more or less sharply striate, often forming a fine granulation with the incremental lines. There is a tendency to banding in the coloration. The axis is solid and twisted behind, the later part tubular and larger. The aperture is unarmed. Only *approximatus* lacks the spiral striation, if the single specimen available is normal.

Group of *N. ustulatus* (**Nuciscus** n.).

- N. ustulatus* Sowerby, with five varieties.
- N. calvus* Sowerby, with one variety.
- N. elaeodes* Dall.
- N. haemerodes* Dall.
- N. pallidus* Reibisch.
- N. cinerarius* Dall (+ *cinereus* Reibisch).
- N. rugatinus* Dall (+ *acutus* Reibisch).
- N. jacobi* Sowerby.
- N. tanneri* Dall.
- N. perrus* Dall.



This group is near the presumed original ancestor and is most widely distributed among the islands, being particularly numerous on the largest island, Albemarle. The shells are small, robust, rather stout and short, with fine spiral striations to which in dusty situs is added strong corrugation of the surface. There is a tendency to a pale band at the periphery and the species vary from whitish to brown. They are mostly ground lovers but ascend the bushes to some extent during the season of rains. The aperture is unarmed, the axis wholly tubular and hardly twisted.

Group of *N. hoodensis* Dall.

This is represented on the islands, as far as known, by a single species which resembles the continental type more than the other island forms. It is rather brightly banded and the adult has a thickened and reflected peritreme, a feature unique among the island species.

Group of *N. unifasciatus* (**Reclasta** n.).

- N. unifasciatus* Sowerby (not Reibisch).
- N. olla* Dall, with one variety.

By their thin and capacious shells these are readily separable from the other groups. They tend to brownish or dingy olive color with pale peripheral band. They are well distributed among the islands and in the active state appear to frequent shrubbery. They are finely axially wrinkled, polished and obscurely spirally striated with an occasional elevated line of granules which in the young bear short hairs which soon drop off. The aperture is unarmed and the axis as in the section *Nuciscus*.

Group of *N. eschariferus* (**Adenodia** n.).

- N. eschariferus* Sowerby, and one variety, *pileatus*.
- N. ventrosus* Reibisch.
- N. subconoidalis* Ancey.
- N. perspectivus* Pfeiffer.

These are residents of the more arid zone, mostly found under rocks, etc., and, like many of the other ground lovers, sometimes finely granulose. The shells are thin, slender, elevated, usually polished, but in the variety *pileatus* the periostracum is raised into close low dull spiral lamellae. Traces of these may be noted on some of the polished specimens, and in all the apical whorls are sharply transversely ribbed. The peritreme is slightly expanded, the axis tubular, slender, and quite simple. The distribution is rather scattered.

Group of *N. snodgrassi* (**Stemmodiscus** n.).

*N. snodgrassi* Dall.

*N. cucullinus* Dall.

*N. galapaganus* Dall.

This group is confined to Hood, Gardner, Charles, and Barrington Islands, and externally is not to be distinguished from *Adenodia*. The internal structure is entirely different. The earlier part of the axis is simple and tubular as in many other Galapagos species, but in the first half of the last whorl, invisible from the aperture, a semi-circular disk-like flange projects (in the type) at right angles to the axis into the lumen of the whorl and about half way toward the outer wall of the whorl. This dwindles in front and behind into a short plaitlike ridge on the axis which does not enter the penultimate whorl or reach far enough forward to become visible from the aperture. This arrangement recalls the lamina in *Phenacotaxus umbilicatellus* Pilsbry, of Peru, except that it is confined to the first half of the last whorl, while in the Peruvian shell the lamina occupies part of three whorls and has its major expansion in the penultimate whorl.<sup>2</sup> In *N. cucullinus* the flange is shorter, rounder and less prominent than in *N. snodgrassi*, while in *N. galapaganus* it is thick and rounded.

Group of *N. amastroides* (**Olinodia** n.).

*N. amastroides* Ancey.

*N. nucula* Pfeiffer.

*N. trogonius* Dall.

This group of small greenish-olive, ground-loving species is known from Chatham, Charles, and Albemarle Islands. It must be rather close to the presumed ancestral type. The axis is simple, slender and twisted.

Group of *N. simrothi* (**Saeronia** n.).

*N. simrothi* Reibisch.

*N. tortuganus* Dall.

*N. albemarlensis* Dall.

This is a group peculiar to Albemarle Island and its associate islets as far as known; ground loving, found under leaves and on low bushes, and in the grassy zone. They are small, short and stout, dull surfaced, more or less roughly wrinkled or corrugated, the adults having a

<sup>2</sup> Smiths. Misc. Coll. 59: No. 14, p. 9, figs. 2. 1912.



nodule on the pillar and an inward projection on the middle of the outer lip. The axis is thin, slender and twisted except in the last whorl and usually has a purple stain on it not visible from the aperture. The figures named *simrothi* in my monograph of 1900, are really taken from specimens of *tortuganus*, a correction made possible by the receipt of authentic specimens of *simrothi*.

This group initiates the series of species with apertural armature which renders the group of *Naesiotus* so peculiar.

Group of *N. wolfi* (**Ochsneria** n.).

*N. akanatus* Dall.

*N. adelphus* Dall.

*N. wolfi* Reibisch.

*N. lycodus* Dall.

*N. alethorhytidus* Dall.

*N. cymatias* Dall.

*N. ochsneri* Dall.

*N. saeronius* Dall.

This group is confined to Indefatigable Island, and is a denizen of the arid zone though occasionally found on trees during the rainy season. The form is short and stout, the surface more or less corrugated, in some species to an extraordinary extent; there is a strong nodule on the pillar, another on the body, both usually more or less prolonged as a ridge into the interior of the last whorl; and sometimes one on the outer lip. *N. saeronius* is one of the smallest of the *Naesioti*. All the species are unusually solid.

Group of *N. duncanus* (**Granitza** n.).

*N. duncanus* Dall.

*N. jervisensis* Dall.

*N. darwini* Pfeiffer.

These species are found on James, Jervis, Duncan, and possibly Bindloe Islands. The shells are large, thin, short, with feeble tuberculations on the pillar, body and outer lips. The upper part of the axis is very slender and twisted. Only *N. darwini* has been found living.

Group of *N. sculpturatus* (**Granella** n.).

*N. sculpturatus* Pfeiffer.

*N. rabidensis* Dall.

*N. rugiferus* Sowerby.

*N. naesioticus* Dall.

*N. reibischi* Dall.

*N. nudus* Reibisch.

These forms are known from James, Rabida (or Jervis) and Indefatigable Islands. The doubtful *N. nudus* is reported from Charles Island. They are irregularly axially ribbed, sharply spirally striate, granulose and corrugated, slender and thin, with unarmed aperture, slender and more or less solid twisted axis and numerous whorls. They indicate the transition from the more normally formed species toward the peculiarly shaped *Pleuropyrgus*.

Group of *N. chemnitzioides* (*Pleuropyrgus* Martens).

*N. chemnitzioides* Forbes.

*N. lima* Reibisch.

*N. habeli* Stearns, and variety *terebra* Reibisch.  
*N. indefatigabilis* Dall.

This group appears to be restricted to the arid zone of Chatham Island, except the last species which is reported from Indefatigable and James Islands. The species are very slender, with very numerous whorls usually axially ribbed, with a solid slender and twisted axis and unarmed aperture.

Group of *N. canaliferus* (*Pelecostoma* Reibisch).  
*N. canaliferus* Reibisch.

This peculiar species has been found by Wolf only on Chatham Island on moss and ferns at from 900 to 2000 feet elevation. It has numerous flat-sided short whorls, a basal attenuation with a relatively large funicular umbilicus, and a prominent flange on the pillar, which on sectioning the shell is seen to continue as a strong concave plate, surrounding the axis and continued into the penultimate whorl, gradually becoming less prominent. Specimens were obtained by Ochsner from the dry zone, near the beach to 450 feet elevation. Reibisch's second species of *Pelecostoma* is *Tornatellina chathamensis*.

GEOPHYSICS.—*The internal constitution of the earth.* WALTER D. LAMBERT, U. S. Coast and Geodetic Survey.<sup>1</sup>

The title of this paper, "The internal constitution of the earth," was chosen chiefly for brevity. Many of the topics included under that comprehensive heading I shall not touch on at all, and shall deal chiefly with the mechanical properties of the matter in the interior of the earth, and more particularly with its density and its elasticity.

The view that generally prevailed down to recent times and that still persists to some extent as the dictum of popular science is that the interior of the earth is fluid and fiery hot, like molten lava. The volcanoes seem to be offering us samples of the matter within; mediaeval theologians saw in the hot interior of the earth the future abode of sinners. The molten mass of the earth is assumed to have cooled to some extent, thus forming on the outside a crust of undetermined thickness, upon which we live.

<sup>1</sup> The substance of this paper was read before the Maryland-Virginia-District of Columbia Section of the Mathematical Association of America on December 6, 1919.